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NOTES ON SEVERAL LIZARDS OF THE GENUS *EMOIA*

WITH DESCRIPTIONS OF NEW SPECIES FROM THE SOLOMON ISLANDS

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Since my return to the United States from the Pacific theater of World War II, I have been engaged on research on the classification of Pacific Island amphibians and reptiles. When I turned from detailed studies on the amphibians of the Solomon Islands to the reptiles of those islands, a special series of problems was immediately evident in the lizards of the scincid genus *Emoia*. For the furtherance of my studies on *Emoia*, I wish to thank Dr. Karl P. Schmidt and Mr. Clifford H. Pope of Chicago Natural History Museum (C.N.H.M.), Mr. Charles Bogert of the American Museum of Natural History (A.M.N.H.), Mr. Arthur Loveridge of the Museum of Comparative Zoology (M.C.Z.), Dr. Robert Stebbins of the Museum of Vertebrate Zoology at the University of California (M.V.Z.), Dr. George S. Myers of the Stanford Natural History Museum (S.N. H.M.) and Mr. James R. Slater of the College of Puget Sound (C.P.S.), who have lent the material used in this study.

A number of species of *Emoia* exhibit marked modification of the primitive, simply rounded lamellae on the lower surface of the digits (fig. 44). The lamellae are thinned, transversely enlarged, and more numerous beneath the basal phalanges, suggesting adaptation to an arboreal or semi-arboreal habitat. Three or possibly four evolutionary lines within the genus show this modification.

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Cyanogaster Group

The cyanogaster group includes several species, ranging in size from a comparatively small lizard such as *E. kordoana* Meyer to a No. 729 263 moderately large form such as E. cyanogaster cyanogaster Lesson. All are relatively slender with elongate, pointed, depressed snouts and with the number of lamellae beneath the fourth toe very rarely below fifty. The two loreals on either side are of about equal length and both are narrow (fig. 45, a). The interparietal is consistently present in some species, consistently absent in others.



FIG. 44. Under surface of fourth toe of (a) E. baudinii, (b) E. c. cyanogaster.

There exist in the literature descriptions of nine species and three (possibly five) subspecies that refer to members of this group: E. beccarii Doria, E. carteretii Duméril and Bibron, E. cyanogaster Lesson, E. iridescens Boulenger, E. kordoana Meyer, E. longicauda Macleav, E. sorex Boettger, E. speiseri Roux, E. tetrataenia Boulenger, E. cyanogaster keiensis Sternfeld, E. cyanogaster aruensis Sternfeld, E. cyanogaster tongana Werner. Of the nine, E. carteretii is, on the basis of our present knowledge, a synonym of E. c. cyanogaster: E. longicauda is apparently the earliest available name for the race of *cuanogaster* that occupies New Guinea, the islands of Torres Straits and possibly some other islands at the western end of New Guinea; and E. iridescens is a synonym of E. kordoana Meyer. Re-examination of the types, if possible, or examination of more extensive samples of the populations they represent, should be helpful in determining the exact status of E. beccarii and of the three subspecies.

Emoia cyanogaster longicauda Macleay

Specimens examined.—M.C.Z. 9470, Murray Island, Torres Straits (H. L. Clark), 1913; M.C.Z. 45504, Prince of Wales Island, Torres Straits, 1929; C.N.H.M. 43181–82, Doromena, Dutch New

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Guinea (S. G. Jewett, Jr., and H. Cook), 1945; A.M.N.H. 58402, Tarara, Papuan New Guinea (Archbold Expedition), 1938; A.M.N.H. 61958–59, Hollandia, Dutch New Guinea (Archbold Expedition), 1938; A.M.N.H. 66678, Gusika, Australian New Guinea, 1944.

Emoia longicauda Macleay is revived from the synonymy of E. nigra Hombron and Jacquinot and made a race of E. cyanogaster, since this series of specimens from the islands of Torres Straits and New Guinea is in much closer agreement with Macleav's brief description (1877, p. 68) than are typical specimens of E. nigra. Boulenger's placing of E. longicauda in the synonymy of E. nigra (Boulenger, 1887, p. 297) was not without reservation, for an interrogation mark precedes the name and he does not include New Guinea or the islands of Torres Straits in the range of E. nigra. Although Macleay gave no scale counts, his description-"Head rather elongate, and pointed at the muzzle, ... frontonasals contiguous;... the sixth upper labial plate more than twice the size of any of the preceding plates. Ear openings nearly round, with two or three denticulations in front...tail twice the length of the body \ldots "—is characteristic of specimens of this western race of E. cyanogaster but not of E. nigra. Also, on the basis of our present knowledge, the western limits of the range of E. nigra are the islands of the New Hebrides, the Solomons and the Bismarcks, with the exception of one somewhat doubtful record (Valise Island off northeast New Guinea; de Rooy, 1915, p. 261).

Amended diagnosis.—Differs from the typical race in the more uniform color pattern. The broad dark brown to blackish band along the side of the head and upper lateral surface of the body is absent or reduced to a few blotches; the dorsum is often more grayish or grayish-tan, marked frequently by scattered small, dark, and occasionally light spots as is cyanogaster at times. The dorsolateral series of white or bluish spots, so often present in E. c. cyanogaster, is not in evidence in the present series of E. cyanogaster longicauda; the latter is also a larger race. Five of the above eight specimens measure more than 85 mm. from snout to vent, the largest 98 mm. A.M.N.H. 58402, the smallest adult, measuring 79 mm. from snout to vent, is a female. The largest of a series of 24 specimens of c. cyanogaster from the Solomon Islands measures only 85 mm. from snout to vent; two males (C.N.H.M. 44894 and M.C.Z. 15107), measuring 65 and 67 mm., respectively, from snout to vent, are mature, and one female (M.C.Z. 15118), measuring 70 mm. from snout to vent, is gravid.

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Description.—As in the typical race the body is slender; the tail is very long; the snout is long, pointed and depressed, with the two loreals of nearly equal length and very narrow; a small to moderate interparietal is consistently present; prefrontals are large but generally separate in the present series; supranasals are triangular with their moderately broad bases against the rostral; they are not in contact with the anterior loreal; the number of rows of scales around the middle of the body ranges from 24 to 27; the number of rows of scales along the mid-dorsal line from the parietals to the base of the tail varies from 55 to 59; and the number of lamellae under the fourth toe ranges from 73 to 94.

The color (in preservative) is generally grayish-tan or light brown on the dorsum and upper lateral surfaces. The broad, dark brown or blackish band on the body is entirely absent or only suggested by a few small, scattered, brownish spots. Occasionally bluish or bluish-white spots occupying the area of a single scale or less occur on the dorsal and lateral surfaces.

Emoia kordoana Meyer

Euprepes (Mabuya) kordoanus Meyer, 1874, Monatsber. Akad. Wiss. Berlin, 1874: 133-Kordo, Mysore Island, Dutch New Guinea.

Lygosoma iridescens Boulenger, 1897, Ann. Mag. Nat. Hist., (6), 19: 9, pl. I, fig. 4—Mount Victoria, British New Guinea.

Specimens examined.—M.C.Z. 7683, Ansoes, Jobi Island, Dutch New Guinea (T. Barbour), 1907; M.C.Z. 7688, Wooi Bay, Dutch New Guinea (T. Barbour), 1907; M.C.Z. 7689, Sorong, Dutch New Guinea (T. Barbour), 1907; M.C.Z. 48603 (+1 uncatalogued), Aitape, New Guinea (W. M. Beck), 1944; M.C.Z. 49317, Toem, Dutch New Guinea (W. H. Stickel), 1944; C.P.S. 4311, 4327, Cape Endaiadere, Papuan New Guinea (W. C. Brown), 1944; S.N.H.M. 11617, Cape Endaiadere, Papuan New Guinea (W. C. Brown), 1944; A.M.N.H. 58655, Daviumbu, Papuan New Guinea (Archbold Expedition); A.M.N.H. 59172, Kubuna, Papuan New Guinea (Archbold Expedition).

The specimens from New Guinea in the collections of the Museum of Comparative Zoology were referred to E. cyanogaster by Loveridge (1948, p. 366). I called his attention to the probable validity of E. kordoana unfortunately too late for his consideration at that time. He very kindly suggested that I re-examine the material and publish my conclusions at a later date.

Emoia kordoana is a smaller lizard than the races of E. cyanogaster. A male (A.M.N.H. 59172) is mature at a length of 43 mm. from snout to vent, and a female (A.M.N.H. 58655) is gravid at 48 mm. The largest of the present series, a male (C.P.S. 4327), measures 59 mm. from snout to vent. The number of lamellae beneath the digits is generally less than is characteristic of known races of E. *cyanogaster* and the interparietal is consistently absent.

E. kordoana was placed in the synonymy of E. cyanura by Boulenger (1887, p. 290). The name was later revived by Sternfeld (1918, p. 411) but was assigned to the species now recognized as E. callistica Peters and Doria. Schüz (1929, p. 8), after re-examination of the type, again placed E. kordoana in the synonymy of E. cyanura, but with reservation. He did so primarily because of the close correspondence in the number of lamellae under the toes (70-72 under the fourth toe for the type of E. kordoana) and the number of rows of scales around the middle of the body (26 for the type of E. kordoana). Other characteristics—the more depressed snout and the much longer and narrower anterior loreal—distinguish this species from E. cyanura and indicate its closer relationship to the members of the cyanogaster group.

The specimens from Daviumbu and Kubuna—the latter locality is near Mount Victoria, the type locality of E. iridescens—are wholly in agreement with the description of *Emoia iridescens*. Since they cannot be distinguished on morphological grounds (to which our present knowledge is limited) from specimens of E. kordoana from other localities throughout New Guinea, I regard E. iridescens as a synonym of E. kordoana.

Description.—The body is slender; the snout is pointed and depressed; the anterior loreal is as long as the posterior or nearly so and equally narrow; the prefrontals are separate; the supranasals are narrow, triangular, posteriorly in contact with or but narrowly separated from the anterior loreal; the supralabial beneath the orbit (generally the sixth) is large, its length about 50 per cent of its distance from the rostral; the interparietal is absent. The number of rows of scales around the middle of the body ranges from 24 to 28, the number of lamellae beneath the fourth toe from 65 to 82, the number of rows of scales along the mid-dorsal line from the parietals to the base of the tail from 52 to 56 for eleven specimens.

Color (in preservative) on the dorsum grayish olive-green or grayish brown, adults generally with the lateral margins of the scales dark brown or with two or more rows of dark brown spots; a narrow, generally broken, darker band of brown of varying intensity along the upper lateral surfaces from the region of the eye to the hind limb; lower lateral surfaces bluish white to tan; venter of the same color but generally lighter.

This is in close agreement with Meyer's brief description, "Olivenfarbig oben, jede Schuppenreihe von der anderen durch etwas Schwarz geschieden; an den Seiten bläulich, unten gelblichweiss."

In life, C.P.S. 4327 was greenish-brown on the dorsum mottled with darker brown, light brown on the tail; laterally more grayishgreen with an irregular brownish stripe extending from the eye to the hind limb. A juvenile (C.P.S. 4311) was greenish-copper on the dorsum when alive.

Differences in size and scale counts for the species discussed above are summarized in Table I.

INCERTAE SEDIS

Euprepes (Mabuya) carteretii mysorensis Meyer, 1874, Monatsber. Akad. Wiss. Berlin, 1874: 133—Mysore Island, Dutch New Guinea.

Meyer's complete description is as follows: "Schwarzer Streif vom Auge bis an die Vorderextremitäten, Unterseite schön blau."

Euprepes (Mabuya) samoensis moluccensis Peters, 1864, Monatsber. Akad. Wiss. Berlin, 1864: 386—Moti Island, Mollucas.

Peters' description is as follows: "Oben olivenbraun mit metallischem Glanze und unregelmässig schwarz gesprenkelt, unten grüngelb. Die Supranasalia viel kleiner und die Ohröffnungen enger, sonst in der Gestalt und Pholidosis so sehr mit *E. samoensis* übereinstimmend, dass ich nicht wage, das einzige Exemplar, welches Hr. Dr. v. Martens auf der Mollukkeninsel Moti eingesammelt hat, davon zu trennen."

These descriptions may or may not refer to members of the E. cyanogaster group.

Cyanura Group

The members of the cyanura group are small to moderate-sized lizards, distinguished from the members of the cyanogaster group by the less elongate and less depressed snout. The anterior loreal is much shorter and higher than the posterior and in contact anteriorly with the supranasal (fig. 45, b). Descriptions of four species, E. arundeli Garman, E. cyanura Lesson, E. cuniceps de Vis, and E. im-

	Midbody scale-rows	Lamellae on fourth toe	Scale-rows: parietals to base of tail	Size at maturity	Interparieta
Emoia cyanogaster cyanogaster	n=49 $m=24.2\pm0.11$ R=22-26	n=48 $m=86.3\pm0.519$ R=81-95	m=48 $m=58.2\pm0.203$ R=56-60	65 +	Present
Emoia cyanogaster longicauda	n=7 $m=25.9\pm0.375$ R=24-27	n=6 m=84.7±2.54 R=73-94	m=6 $m=57.2\pm1.098$ R=55-59	(¿) +62	Present
Emoia kordoana	m=11 $m=27.1\pm0.374$ R=24-28	n=11 $m=74.4\pm1.318$ R=65-82	n=10 $m=53\pm 0.424$ R=52-56	43 +	Absent
<i>n</i> =number of specimens; <i>m</i> =mean; R=r	ange.				

TABLE 1.—Emoia cyanogaster Group

par Werner, and one subspecies, E. cyanura schauinslandi Werner, refer to members of this group. Emoia cuniceps is placed in the cyanura group because of the close correspondence in scale and lamellae counts to the new species described at this time from the Solomon Islands, although de Vis does not mention the shape of the anterior loreal or discuss the depression of head and snout relative to other species. E. arundeli is a race of cyanura.

E. impar, described from Ralum, New Britain, and Mioko Island in the Bismarcks, and E. cyanura schauinslandi, described from the Hawaiian Islands, may prove to be good races of cyanura when population studies of this widely spread species are completed. E. cuniceps from New Guinea is a distinct species. Two heretofore undescribed species from the Solomon Islands appear to be most closely related to the latter.

Schmidt (1932, p. 187) suggested that the series of specimens from Ugi and Kolombangara Islands in the Solomons, which he referred with reservation to E. cyanura, might actually be a distinct species. Examination of a larger number of specimens from these and other islands of the Solomons group has shown this to be the case. With his permission, it gives me great pleasure to name the species from the New Georgia group in his honor.

Emoia schmidti sp. nov.

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Type.—Chicago Natural History Museum no. 41331, an adult female from New Georgia Island. Collected by William J. Beecher, 1943.

Paratypes.—Twenty-seven specimens, as follows: C.N.H.M. 41327-30, Munda, New Georgia Island (William J. Beecher), 1943; C.N.H.M. 44276, New Georgia Island (T. W. Stixrud), 1945; C.N. H.M. 13853 Kolombangara Island (Karl P. Schmidt), 1929; A.M. N.H. 40312, 40336, and 40338, Kolombangara Island (Whitney Expedition); A.M.N.H. 41311, Arnavon Island (Whitney Expedition); M.V.Z. 44956-61, Munda, New Georgia Island (Charles G. Sibley), 1944; S.N.H.M. 13483, Kolombangara Island (exchange, C.N.H.M.), 1952.

A single specimen (A.M.N.H. 41863) from Oema Island in the Bougainville group is referred to this species but is not made a paratype.

Definition and diagnosis.—An Emoia of moderate size with welldeveloped limbs; snout moderately tapering and bluntly rounded; number of rows of scales around the middle of the body 31-36; number of lamellae beneath the fourth toe 71-87; number of rows of scales along the mid-dorsal line from the parietals to the base of the tail 56-65; interparietal consistently absent; color pattern with a broad, generally uniformly light brown mid-dorsal stripe (3 to 4 and a fraction scale-rows in width) which gradually fades into the blue of the tail posterior to the hind limbs, and a narrow ivory to



FIG. 45. Lateral view of head of (a) E. schmidti, (b) E. cyanogaster. 1=anterior loreal.

pale greenish white dorso-lateral stripe edged dorsally by a narrow dark brown band and laterally by the dark brown of the upper lateral surfaces. Differs from E. cyanura from the same localities in the greater number of rows of scales around the body, the color pattern, the stockier build, and the blunter head and snout; from E. cuniceps in the color pattern, the absence of a distinct interparietal, the lower number of supralabials anterior to the enlarged one beneath the orbit, and the generally smaller size and longer limbs, the adpressed hind limb reaching to the shoulder or beyond (not just to the elbow or a little beyond).

Differences in size and scale-counts are summarized in Table 2.

Description of type.—Body moderately slender; snout moderately tapering and bluntly rounded; supranasals long, in contact with the anterior loreal, which is shorter and broader than the posterior loreal (fig. 45, *a*); prefrontals not in contact; frontal longer than broad, slightly shorter than the fused fronto-parietals; no interparietal; a pair of large nuchals and temporals behind the parietals. Supraoculars 4, plus a small one posteriorly; ear opening about equal in size to the palpebral disk, several small lobules along its anterior border. Fifth and largest supralabial beneath the eye, its length about one-half its distance from the rostral; six infralabials; postmental scarcely longer than the mental; the anterior pair of chinshields in contact. Scale-rows across the nape from ear opening to ear opening 10; scale-rows around the middle of the body 34; from

	Midbody scale-rows	Lamellae on fourth toe	Scale-rows: parietals to base of tail	Size at maturity
Emoia cyanura (Bougainville group)	n=12 $m=27.1\pm0.275$ R=26-28	n=12 $m=88\pm1.632$ R=72-98	n=12 $m=57.9\pm0.399$ R=55-60	45+
Emoia cyanura (Guadalcanal)	n=31 $m=28.2\pm0.214$ R=26-30	n=18 $m=75.1\pm1.41$ R=66-85	n=32 $m=57.8\pm0.313$ R=54-63	44+
Emoia cyanura (Ugi)	n=8 $m=28.6\pm0.466$ R=26-30	n=3 $m=73.3\pm1.44$ R=70-76	n=8 $m=57.9\pm0.728$ R=54-61	47+ (3 meas.)
Emoia cyanura (New Georgia)	n=1 28	n=1 72	$\substack{n=1\\56}$	
Emoia cuniceps* . (New Guinea)	R=33-36	R=75-87	?	?
Emoia maculata	n=24 $m=29.9\pm0.178$ R=28-32	n=23 $m=82.1\pm0.742$ R=74-88	n=24 $m=54.9\pm0.284$ R=52-59	40+
Emoia schmidti	n=27 $m=32.7\pm0.251$ R=31-36	n=27 $m=77.6\pm0.749$ R=72-81	$n=20 \ m=59.5 \pm 0.515 \ R=55-65$	44+

TABLE 2.—Emoia cyanura Group

n=number of specimens; *m*=mean; R=range.

* Based on de Vis' description.

parietals to base of tail 61; lamellae under the fourth toe 70–71. Color: Head and mid-dorsal region (three to four scale-rows in width) light olive brown suffused with darker brown, head somewhat lighter; a light ivory dorso-lateral stripe from the supraciliary region to the hind limbs, bordered dorsally by a narrow blackish brown line (one-half to two half-scales in width), which is broken and irregular on the posterior part of the body, and below by the broad black-brown band (generally four or five scales in width) on the side of the head and upper lateral surface of the body as far posterior as the hind limb. This dark lateral band is marked ventrally by small, whitish or pale bluish green spots; limbs dark brown to black brown, heavily marked with whitish or blue spots; toes with light transverse bars; tail blue, marked with series of brown blotches on the dorsal and lateral surfaces; lower lateral surfaces bluish; venter yellowish, or whitish anteriorly and bluish white posteriorly.

Measurements.—Length of snout 5 mm.; snout to forelimb 11; snout to vent 59; axilla to groin 28; tail 92; forelimb 18; hind limb 27.5; fourth toe 8.

Variation.—The color pattern is very uniform throughout the series.

Emoia maculata sp. nov.

Type.—Chicago Natural History Museum no. 13715, an adult male from Ugi Island. Collected by Karl P. Schmidt in 1929.

Paratypes.—Twenty-three specimens from the following localities: C.N.H.M. 13710-14, 13716, Ugi Island (Karl P. Schmidt), 1929; M.C.Z. 49501-05 (+10 uncatalogued), Wainone Bay, San Cristoval Island (W. M. Mann), 1915; S.N.H.M. 13484, Wainone Bay, San Cristoval Island (exchange, M.C.Z.).

Definition and diagnosis.—A small Emoia with well-developed limbs; snout moderately tapering and round-pointed; number of scale-rows around the middle of the body 28-32; number of lamellae beneath the fourth toe 74-88; number of scale-rows from the parietals to the base of the tail 52-59; interparietals consistently absent; color pattern with a mid-dorsal light stripe which is two plus two half scale-rows in breadth at the nape but basically two-plus along the back. Margins are uneven, however, and in the two rows of dark scales separating the mid-dorsal from the dorso-lateral light stripes, at intervals of one to four scales, are light blotches covering a part or all of a scale. The light stripes are greenish bronze in the head region, greenish blue on the body, and merge with the blue of the tail posteriorly. Differs from E. cuanura from the same locality in the distinctive color pattern and the slightly greater number of rows of scales around the middle of the body: from E. schmidti, to which it appears to be most closely related, in the generally smaller size, lower number of scales around the middle of the body, and color pattern.

Description of type.—Body moderately slender; snout moderately tapering, rounded; supranasals long and narrow, in contact with the anterior loreal on one side (barely separated from it on the other); anterior loreal shorter and broader than the posterior; prefrontals rather widely separated; frontal longer than broad, shorter than the fused fronto-parietals, no interparietal; a pair of large nuchals and temporals behind the parietals; supraoculars four plus a small one posteriorly; ear opening and palpebral disk equal in size; fifth and largest supralabial beneath the eye, its length about three-fourths of its distance from the rostral; postmental longer than the mental; the anterior pair of chinshields in contact; scalerows across the nape from ear to ear 10, around the middle of the body 28, from the parietals to the base of the tail 55; number of lamellae under the fourth toe 75.

Color: Head and mid-dorsal band (two to two and two half scale-rows in width) light greenish yellow or bronze anteriorly, becoming more greenish blue on the posterior half of the body before it merges into the light blue of the tail, heavily blotched with blackish-brown on the head and with scales dark bordered or with scattered spots of blackish brown; dorso-lateral stripes (one to one and one-half scale-rows in width) are also light greenish vellow anteriorly, greenish blue posteriorly, bordered above by a narrow blackish brown band (two half scales to two scale-rows in width) and below by a black-brown band beginning on the snout, passing through the eve and above the ear and ending in the region of the hind limb (generally two to two and one-half scale-rows in width along the flank). Frequent light spots occupying the area of a scale or less tend to mark those areas along the borders of the mid-dorsal and dorso-lateral stripes, giving a much more spotted appearance than is characteristic of Emoia schmidti.

The blackish brown bands tend to be continued on the blue tail as four series of dark blotches gradually disappearing toward the tip. The lower lateral surfaces are bluish; the venter is white or yellowish-white, faintly tinted with blue. The upper surfaces of the limbs are dark brown spotted with blue or bluish-green, the toes transversely barred with blue or bluish-white.

Measurements of type.—Length of snout 5 mm.; snout to forelimb 20; snout to vent 50; axilla to groin 22; tail 65; forelimb 15.5; hind limb 23; fourth toe 7.

Variation.—The irregular margins of the dorso-lateral light stripes and the regular pattern of light scales along the dorsal stripe are frequently more pronounced than in the type (C.N.H.M. 13711–13, for example). Preservation in formalin makes the specimens generally darker and the spotted pattern less conspicuous.

Remarks.—E. maculata appears to be related to E. schmidti but since they are apparently morphologically distinct and geographically isolated, there being no evidence of intergradation or even occupancy by either form of the intermediate island group (the Guadalcanal group), I regard them as distinct species. Both overlap the distribution of E. cyanura without known evidence of intergradation. Schmidt (1932, p. 186) noted that a series (C.N.H.M. 13706–08) from Ugi Island contained typical specimens of cyanura. A single specimen (C.N.H.M. 44275), as is true of others collected by Mr. T. W. Stixrud, bore only the locality data, Solomon Islands. However, in his correspondence with Mr. Pope he mentions collecting only on New Georgia Island. The distribution within the Solomons of all three species, based upon the specimens I have examined, follows:

E. cyanura: Arnavon, Bagga, Banika, Bougainville, Fatura, Fauro, Guadalcanal, Isabel, Malaita, New Georgia, Santa Ana, Savo, Sterling, Treasury, Tulagi, Ugi.

E. schmidti: Arnavon, Kolombangara, New Georgia, Oema.

E. maculata: San Cristoval, Ugi.

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